Measuring electron emission from irradiated biomolecules

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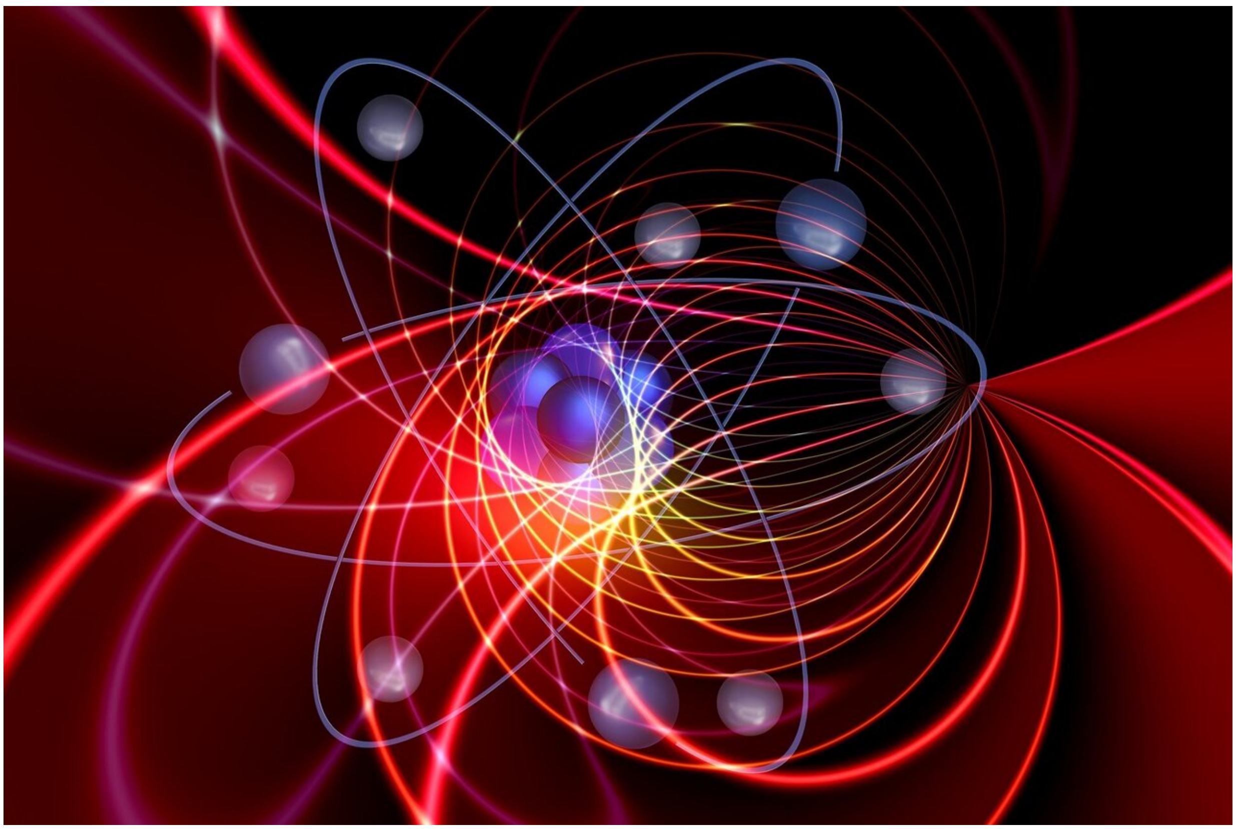

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When fast-moving ions cross paths with large biomolecules, the resulting collisions produce many low-energy electrons which can go on to ionize the molecules even further. To fully understand how biological structures are affected by this radiation, it is important for physicists to measure how electrons are scattered during collisions. So far, however, researchers' understanding of the process has remained limited. In new research published in *EPJ D*, researchers in India and Argentina, led by Lokesh Tribedi at the Tata Institute of Fundamental Research, have successfully determined the characteristics of electron emission when high-velocity ions collide with adenine—one of the four key nucleobases of DNA.

Since high-energy ions can break strands of DNA as they collide with them, the team's findings could improve our understanding of how radiation damage increases the risk of cancer developing within cells. In their experiment, they considered the 'double differential cross section' (DDCS) of adenine ionization. This value defines the probability that electrons with specific energies and scattering angles will be produced when ions and molecules collide head-on, and is critical for understanding the extent to which biomolecules will be ionized by the electrons they emit.

To measure the value, Tribedi and colleagues carefully prepared a jet of adenine molecule vapor, which they crossed with a beam of high-energy carbon ions. They then measured the resulting ionization through the technique of electron spectroscopy, which allowed them to determine the adenine's electron emissions over a wide range of energies and scattering angles. Subsequently, the team could characterize the DDCS of adenine-ion collision; producing a result which largely agreed with predictions made by computer models based on previous theories. Their findings could now lead to important advances in our knowledge of how biomolecules are affected by high-velocity ion radiation; potentially leading to a better understanding of how cancer in cells can arise following radiation damage.

More information: Shamik Bhattacharjee et al, Electron emission in

ionization of adenine molecule induced by 5 MeV/u bare C ions, *The European Physical Journal D* (2020). DOI: 10.1140/epjd/e2020-10151-3

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